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(54) **High-density packaging for multiple removable electronics subassemblies**

Packung hoher Dichte für mehrere entfernbare elektronische Baugruppen

Emballage à haute densité des multiples sous-assemblages électroniques amovibles

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**EP-A- 0 502 300** **DE-A- 4 104 984**

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## Description

### Background of the Invention

The present invention relates to the physical packaging of electronic circuits and similar items, and more particularly concerns a system for mounting multiple subassemblies at high density on a single base card. Such a system is known from DE-A-4 104 984.

Electronic and optoelectronic circuits seem to decrease in physical size almost without limit. This usually does not result in a decrease in the size of the overall system, but rather the inclusion of ever increasing numbers of circuits within a single system. In many systems, such as switching systems, communications systems, and the like, the demand is to package larger numbers of a common subassembly within the same frame. For example, a system for interconnecting multiple optical fibers may require dozens of "link cards" which each convert a serial optical signal at gigabit frequencies into a parallel electrical signal and vice versa. In such systems, the high signal frequencies also make small physical size and dense packaging very desirable.

Previous advances in electronics packaging at the card or subassembly level have required large spacing between adjacent subassemblies for insertion and removal, have been difficult to insert and remove, have been fragile or expensive, or have interfered with heat dissipation from the system.

### Summary of the Invention

The present invention focuses upon increasing packaging density by decreasing the allowable spacing between subassemblies according to claims 1 to 9 mounted on a common base card, while preserving ease of inserting and removing the individual subassemblies; in fact, no tools are required for either insertion or removal. The packaging is inexpensive, rugged, easily manufactured, simple to operate, and does not interfere with heat dissipation, the other major problem of high packaging density.

In a system or overall assembly according to claims 10 and 11, a base card has a row of elongated slots. A number of individually insertable subassemblies have standoff feet and a pair of offset hooks at their sides. The hooks snap into the slots in such a way that each slot can hold the hooks for four different subassemblies, which are positioned adjacent each other and on both sides of the base card.

### Description of the Drawings

FIG. 1 is a perspective view of a base card and a number of subassemblies according to an embodiment of the invention.

FIG. 2 is a perspective view of the top of a sub-

assembly shown in Fig. 1.

FIG. 3 is a perspective view of the bottom of the subassembly shown in Fig. 2.

FIG. 4 is a perspective view of a frame for another form of a subassembly according to the invention.

### Description of a Preferred Embodiment

FIG. 1 shows a portion of an electronics system 100 whose overall function may be, for example, to interconnect incoming signals from a large number of fiber-optic cables, a few of which are shown at 111-113, selectively to multiple outgoing signals on other fiber-optic cables, such as 115-117. Panel 120, through which the cables are connected, may be a part of an overall enclosure for the system.

System 100 includes one or more base cards 200 each carrying multiple removable subassemblies 300. Base card 200 is positioned in a plane indicated by direction arrows 201 and 202. Fig. 1 shows only a portion of a base card, a full base card may extend much farther in the direction of arrows 201 and 202. Also, additional base cards, not shown, may be stacked in parallel planes atop card 200, in the direction of arrows 203. Base card 200 may be attached directly to panel 120, or may be attached to some other frame or similar means not shown.

Base card 200 is a printed circuit card of conventional design, and carries wiring, a small portion of which is indicated at 210, in surface and/or internal planes. Connectors 211 are coupled to the wiring to distribute electrical signals and power, both among the connectors and to and from other components, not shown.

Base card 200 has a row 220 of elongated obround slots 221-223 cut through the card. (A portion of subassembly 300 has been cut away in Fig. 1 to reveal the location of slot 223.) Row 220 extends in the direction of arrows 201, but the long axis of each slot extends in the direction of arrows 202, perpendicular to the direction of the row. In addition, card 200 contains a row 230 including locating holes 231, as well as additional holes not visible in Fig. 1. Row 230 is parallel to row 220.

A number of subassemblies 300 are individually removably mounted on base card 200. FIGs. 2 and 3 show top and bottom views of one of these subassemblies.

Printed-circuit subassembly card 310 carries electronics components such as 311-314, which may be attached by surface-mount technology (SMT) or other conventional means. In this example, these components form circuits for converting parallel electrical signals to and from serial signals for transmission in optical fibers. Conventional connector 315 mates with connector 211 to transfer the parallel signals via wiring 210. Fig. 1

A molded plastic card retainer or frame 320 contains a lip 321 and tabs 322 for engaging and holding

three sides of card 310 the card may be inserted into the frame during manufacture of the subassembly 300 merely by pushing it upward past the tabs until it locks into place under the lip. The fourth edge of the card carries optical components: a laser 317 and a photodetector 316, for converting the serial electrical signals to and from optical signals on cables such as 111 and 115. Sockets 331 and 332 for the cables are a one-piece mold which surrounds the optical components, and snaps into housing 330. Housing 330 is preferably molded in a single piece with frame 320, although these could be separate if desired.

Frame 320 has four feet or standoffs projecting in the direction of arrows 203, perpendicularly downward from the plane defined by frame 320 and card 310, at each corner of circuit card 310. Rear feet 323 have flat surfaces, but front feet 324 have short molded pins 325. The long sides of frame 320 have integrally molded hooks 326. Each hook has a barb 327 with an undersurface 328 and a sloped camming surface 329. As may be seen in Fig. 3, hooks 326 are not directly across from each other on frame 320. Rather, one hook is set forward, toward housing 330, while the other is set back, farther away from the housing. This offset between the two hooks equals or slightly exceeds the width of the hooks in the direction of arrows 202. Hooks 326 are sufficiently long (direction 203) and thin (in direction 201) that they are somewhat flexible yet resilient.

FIG. 1 shows how multiple subassemblies 300 are mounted on a single base card 200. The subassembly at the upper right of Fig. 1 is pushed downward so that barbs 327 of hooks 326 pass through slots 222 and 223, pins 325 seat in the appropriate holes 231, and connector 315 mates with connector 211. The spacing of hooks 326 from each other is substantially equal to the spacing between slots, so that camming surfaces 329 engage the sides of the slots. The resilience of the hooks 326 pushes them apart and through the slots as further downward pressure is applied to the subassembly frame. The relative height of feet 323 and 324, and the length of hooks 326 are preferably such that a slight flexure of frame 320 is required before barbs 327 pass completely through their respective slots so that undersurfaces 328 engage the opposite side of the base card. At that point, releasing downward pressure on the frame causes it to spring back, and to pull undersurfaces into firm engagement with the base card adjacent slots 222 and 223. Preferably, undersurfaces 328 are slightly bevelled so that the subassembly is retained on base card 200, yet a moderate upward pressure applied to the subassembly frame will cam them apart and allow the subassembly to be removed from the base card 200; bevel angles of ten to thirty degrees have been found to give an acceptable range of tensions.

In applications where more permanent mounting is desired, additional holes 32A in frame 320 allow self-tapping screws to be inserted through some of the holes 231 in base card 310.

Slots 221-223 are made slightly longer than twice the width of a hook 326 and slightly wider than twice the thickness of a hook. Thus the hooks 326 on the upper right subassembly engage the forward left quarter of slot 223 and the rear right quarter of slot 222. This allows another subassembly of exactly the same construction (only whose hooks are shown in Fig. 1) to be mounted directly under the upper right subassembly also in slots 222 and 223. The hooks of this lower right subassembly then occupy the forward right quarter of slot 222 and the rear left quarter of slot 223, because this subassembly is upside down with respect to the upper right subassembly. A third subassembly (again, only its hooks are shown) can be mounted in slots 221 and 222, as shown at the lower left of Fig. 1. The hooks of this subassembly occupy the rear left quarter of slot 222 and the forward right quarter of slot 221. Yet a fourth card, omitted entirely from Fig. 1 for clarity, may then be pushed downward at the upper left of Fig. 1, so that its hooks engage the forward left quarter of slot 222 and the rear right quarter of slot 221.

At this point in the assembly, the single slot 222 engages the hooks from four different subassemblies. Extending base card 200 in the direction of arrows 201 allows additional subassemblies to be mounted in very close proximity to each other, by filling more of the slots with four hooks. Stacking additional base cards (not shown) would allow even more subassemblies to fit compactly within a single overall unit. For example, one version of subassembly 300 measures 102.6mm long, 35.25mm wide, and 11.85mm high. The present invention allows four subassemblies to be contained within a volume of 102.6mm by 72.1mm by 25.0mm. That is, the spacing between subassemblies is only 1.58mm in width and 1.35mm (the thickness of the base card) in height.

FIG. 4 shows a disengagement means 340 on a modified frame 320 of a subassembly 300. In this version, a wire bail 341 lies atop the frame, and rear feet 323 are somewhat shortened. Pulling upward on handle 342 causes elbow 343 to rotate about a rounded fulcrum 344 formed in foot 323, thereby pushing arm 345 downward. When the subassembly is mounted on a base card, arm 345 pushes against the base card, pulling hooks 326 out of their slots, and also applies a large disengagement pressure to separate the mated connectors. The subassembly may then be removed easily. A forward portion 346 of foot 323 and the surface of card 310 cooperate to trap bail 341 so that it cannot fall out of frame 320 when the subassembly is removed.

Other modifications within the scope of the invention will be apparent to those skilled in the art. Having described a preferred embodiment thereof, we claim as our invention:

# Claims

1. An electronics subassembly for mounting on a base card (200) positioned in a base plane (201) and having at least one row (220) of elongated slots each having an axis in a first direction (202), said slots being spaced across said base card in a second direction (201) and having a plurality of electrical base card connectors (211) mounted thereon, said subassembly comprising

a circuit card (310) positioned in a plane parallel to said base plane,

a connector (315) for mating with one of said base-card connectors,

a pair of substantially straight side edges (321) extending in a direction transverse to said second direction,

at least two spaced-apart feet (323) projecting from said subassembly and having a length sufficient to rest on said base,

at least two spaced-apart hooks (326) projecting from respective ones of said side edges of said subassembly, each of said hooks having a shape for engaging a different one of said slots so as to cause said feet to exert pressure upon said base card and each of said hooks being located at a different position along its respective side edge, so that each of said hooks engages its respective slot at a location along said respective slot such that adjacent hooks of two different ones of said subassemblies engage the same slot at different locations along the axis of said same slot.

2. A subassembly according to claim 1, wherein said subassembly includes a circuit card (310) and frame means (320) at least partially surrounding said card in the plane of said card.
3. A subassembly according to claim 1 or 2, wherein said base card includes a row of locating means (231), and wherein said feet have corresponding subassembly locating means (325) fitting into said locating means on said base card.
4. A subassembly according to claim 3, wherein said subassembly has four corners, and has one of said feet at each of said corners.
5. A subassembly according to anyone of claims 1 to 4 wherein said hooks are bevelled sufficiently for releasing said subassembly from said base card by upward pressure on said subassembly

6. A subassembly according to anyone of claims 1 to 5 wherein said subassembly further includes a bail (341) for camming said subassembly away from said base

7. A subassembly according to anyone of claims 1 to 6 wherein said subassembly further includes socket means (331, 332) at one end thereof, for connecting cables parallel to said circuit-card plane

8. A subassembly according to claim 7, wherein said socket means accepts optical cables (111 to 117)

9. A subassembly according to claim 7 or 8 which further includes an optical source (317) and optical detector (316), mounted in said socket means.

10. An electronics assembly, comprising:

at least one base card (200) positioned in a base plane (201) and having at least one row (220) of elongated slots (221, 223) each having an axis in a first direction (202), said slots being spaced across said base card in a second direction (201) and having a plurality of electrical base card connectors (211) mounted thereon; and

a plurality of subassemblies (300) according to anyone of claims 1 to 8 removably mounted on each base card, each said subassembly being positioned in a plane parallel to said base card

11. An assembly according to claim 10, wherein said base card has upper and lower sides, each having a plurality of said electrical base card connectors, and wherein said plurality of subassemblies are mounted on both sides of said base card in said one row of said slots.

## Patentansprüche

1. Elektronische Baugruppe zur Montage auf einer Grundplatte (200) die in einer Grundebene (201) positioniert ist und wenigstens eine Reihe (220) länglicher Schlitz aufweist, von denen jeder eine Achse in einer ersten Richtung (202) besitzt, wobei die Schlitz in Abständen auf der Grundplatte in einer zweiten Richtung (201) angeordnet sind und wobei diese eine Vielzahl darauf montierter elektrischer Grundplattensteckverbinder (211) besitzt, wobei die Baugruppe folgendes umfaßt:

eine Leiterplatte (310), die in einer Ebene parallel zu der Grundebene angeordnet ist,

einen Steckverbinder (315), der zu einem der

Grundplattensteckverbinder paßt

ein Paar im wesentlichen geradflankige Seiten (321) die sich in einer zu der zweiten Richtung querverlaufenden Richtung erstrecken

wenigstens zwei räumlich voneinander getrennte Füße (323), die von der Baugruppe hervorstehen und die eine Länge besitzen die ausreichend ist, um auf der Grundplatte aufzusitzen,

wenigstens zwei räumlich voneinander getrennte Haken (326), die von der jeweiligen Seitenkante der Baugruppe hervorstehen wobei jeder der Haken eine Form hat, um in einen anderen der Schlitz einzurasten, um zu bewirken, daß der Fuß Druck auf die Grundplatte ausübt, und wobei jeder Haken an einer anderen Position entlang seiner jeweiligen Seitenkante angeordnet ist, so daß jeder der Haken in seinen jeweiligen Schlitz an einem Ort entlang des jeweiligen Schlitzes einrastet, so daß benachbarte Haken von zwei unterschiedlichen der Baugruppen in dem gleichen Schlitz an unterschiedlichen Orten entlang der Achse des gleichen Schlitzes einrasten.

2. Baugruppe gemäß Anspruch 1, bei der die Baugruppe eine Leiterplatte (310) und ein Rahmenmittel (320) enthält, das die Platine in der Ebene der Platine zumindest teilweise umschließt.
3. Baugruppe gemäß Anspruch 1 oder 2, bei der die Grundplatte eine Reihe Lagebestimmungsmittel (231) enthält und wobei die Füße Lagebestimmungsmittel für die jeweilige Baugruppe (325) besitzen, die in die Lagebestimmungsmittel der Grundplatte passen.
4. Baugruppe gemäß Anspruch 3, bei der die Baugruppe vier Ecken besitzt und die an jeder der Ecken einen der Füße hat.
5. Baugruppe gemäß einem der Ansprüche 1 bis 4, bei der die Haken ausreichend abgeschrägt sind, um die Baugruppe von der Grundplatte durch Aufwärtsdruck der Baugruppe freizugeben.
6. Baugruppe gemäß einem der Ansprüche 1 bis 5, bei der die Baugruppe weiterhin einen Bügel (341) enthält, um die Baugruppe von der Grundplatte abzuheben.
7. Baugruppe gemäß einem der Ansprüche 1 bis 6, bei der die Baugruppe weiterhin Sockelmittel (331, 332) an einem seiner Enden enthält, um Kabel parallel zu der Leiterplattebene anzuschließen

8. Baugruppe gemäß Anspruch 7, bei der die Sockelmittel optische Kabel (111 bis 117) aufnehmen

9. Baugruppe gemäß Anspruch 7 oder 8, die weiterhin eine optische Quelle (317) und einen optischen Empfänger (316) enthält, die auf den Sockelmittel montiert sind

10. Elektronischer Aufbau, der umfaßt:

wenigstens eine Grundplatte (200), die in einer Grundebene (201) positioniert ist und wenigstens eine Reihe (220) langgezogener Schlitz (221, 223) aufweist, von denen jeder eine Achse in einer ersten Richtung (202) besitzt, wobei die Schlitz in Abständen auf Grundplatte in einer zweiten Richtung (201) angeordnet sind und eine Vielzahl elektrischer Grundplattensteckverbinder besitzen, die darauf montiert sind; und

eine Vielzahl Baugruppen (300) gemäß einem der Ansprüche 1 bis 8, die lösbar auf jeder Grundplatte befestigt sind, wobei jede der Baugruppen in einer Ebene parallel zu der Grundplatte positioniert ist.

11. Aufbau gemäß Anspruch 10, bei dem die Grundplatte obere und untere Seiten besitzt, von denen jede eine Vielzahl der elektrischen Grundplattensteckverbinder besitzt und bei dem die Vielzahl Baugruppen auf beiden Seiten der Grundplatte in der einen Reihe der Schlitz montiert sind

## Revendications

1. Sous-ensemble électronique pour montage sur une carte de base (200) positionnée dans un plan de base (201) et comportant au moins une rangée (220) d'emplacements pour carte de forme allongée ayant chacun un axe dans une première direction (202), lesdits emplacements pour carte étant espacés à travers ladite carte de base dans une seconde direction (201) et comportant une pluralité de connecteurs électriques de carte de base (211) montés sur ceux-ci, ledit sous-ensemble comprenant :

une carte de circuit (310) positionnée dans un plan parallèle audit plan de base,

un connecteur (315) pour s'adapter à un desdits connecteurs de carte de base,

une paire de bords latéraux sensiblement rectilignes (321) s'étendant dans une direction transversale à ladite seconde direction.

au moins deux pieds espacés (323) dépassant dudit sous-ensemble et présentant une longueur suffisante pour reposer sur ladite base.

au moins deux crochets espacés (326) dépassant des bords respectifs desdits bords latéraux dudit sous-ensemble, chacun desdits crochets ayant une forme de façon à engager un emplacement pour carte différent parmi lesdits emplacements pour carte de façon à amener lesdits pieds à exercer une pression sur ladite carte de base et chacun desdits crochets étant positionnés à une position différente le long de son bord latéral respectif, d'une manière telle que chacun desdits crochets engage son emplacement pour carte respectif à un emplacement le long dudit emplacement pour carte d'une manière telle que les crochets adjacents de deux sous-ensembles différents parmi lesdits sous-ensembles engagent le même emplacement pour carte à des emplacements différents le long de l'axe dudit même emplacement pour carte.

2. Sous-ensemble selon la revendication 1, dans lequel ledit sous-ensemble comprend une carte de circuit (310) et un moyen de cadre (320) entourant au moins partiellement ladite carte dans le plan de ladite carte.
3. Sous-ensemble selon la revendication 1 ou 2, dans lequel ladite carte de base comprend une rangée de moyens de positionnement (231) et dans lequel lesdits pieds ont des moyens de positionnement de sous-ensemble correspondant (325) s'adaptant dans lesdits moyens de positionnement dans ladite carte de base.
4. Sous-ensemble selon la revendication 3, dans lequel ledit sous-ensemble comporte quatre coins et à un desdits pieds à chacun desdits coins.
5. Sous-ensemble selon l'une quelconque des revendications 1 à 4, dans lequel lesdits crochets sont suffisamment chanfreinés pour libérer ledit sous-ensemble de ladite carte de base par la pression vers le haut sur ledit sous-ensemble.
6. Sous-ensemble selon l'une quelconque des revendications 1 à 5, dans lequel ledit sous-ensemble comprend de plus une oreille (341) pour effet de came pour que ledit sous-ensemble soit séparé de ladite base.
7. Sous-ensemble selon l'une quelconque des revendications 1 à 6, dans lequel ledit sous-ensemble comprend de plus un moyen de connecteur femelle (331, 332) à une extrémité de celui-ci, pour connec-

ter des câbles parallèles audit plan de la carte de circuit

8. Sous-ensemble selon la revendication 7 dans lequel ledit moyen de connecteur femelle reçoit des câbles optiques (111 à 117)
9. Sous-ensemble selon la revendication 7 ou 8 qui comprend de plus une source optique (317) et un détecteur optique (316) montés dans ledit moyen de connecteur femelle

#### 10. Ensemble électronique, comprenant :

au moins une carte de base (200) positionnée dans un plan de base (201) et comportant au moins une rangée (220) d'emplacements pour carte de forme allongée (221, 223) ayant chacun un axe dans une première direction (202), lesdits emplacements pour carte étant espacés à travers ladite carte de base dans une seconde direction (201) et ayant une pluralité de connecteurs de carte de base électriques (211) montés sur ceux-ci ; et

une pluralité de sous-ensembles (300) selon l'une quelconque des revendications 1 à 8 montés de manière amovible sur chaque carte de base, chaque dit sous-ensemble étant positionné dans un plan parallèle à ladite carte de base.

11. Ensemble selon la revendication 10, dans lequel ladite carte de base comporte des côtés supérieur et inférieur, chacun comportant une pluralité desdits connecteurs de carte de base électriques, et dans lequel ladite pluralité des sous-ensembles est montée sur les deux côtés de ladite carte de base dans ladite rangée desdits emplacements pour carte.

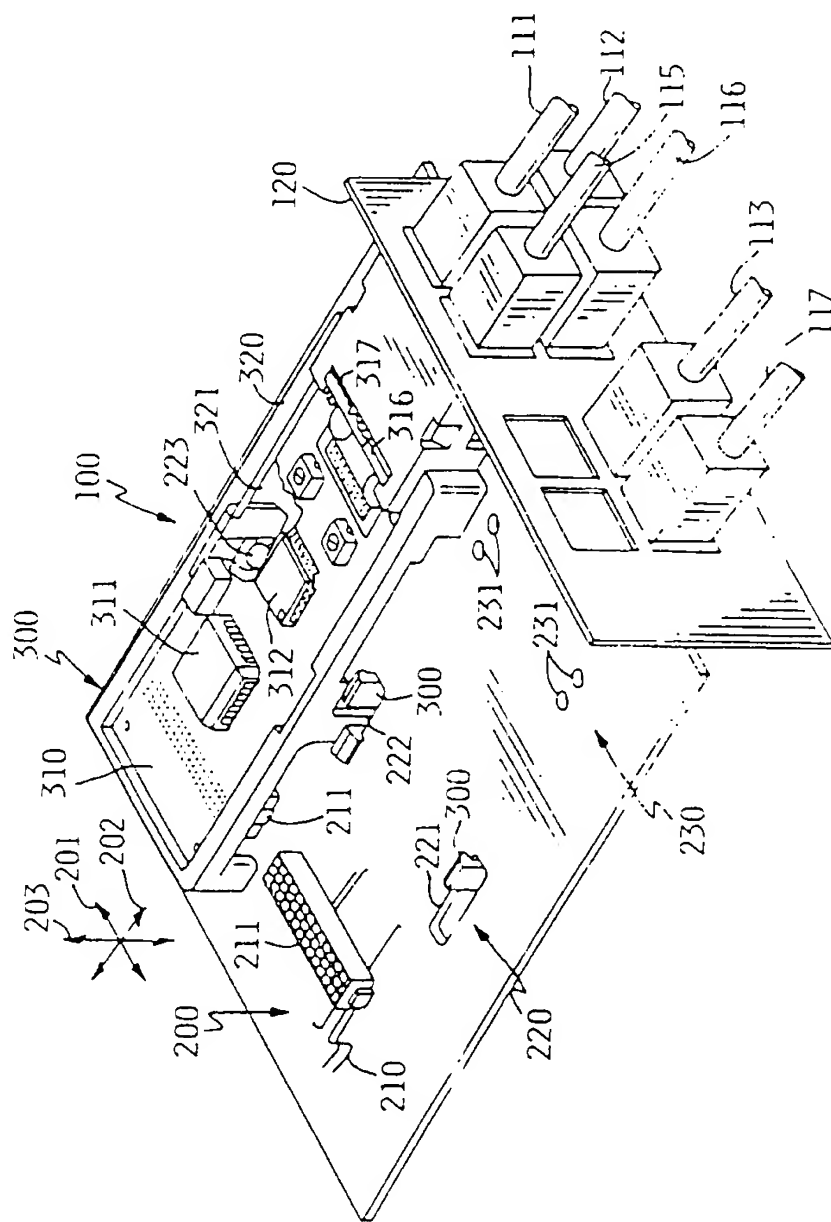


FIG. 1

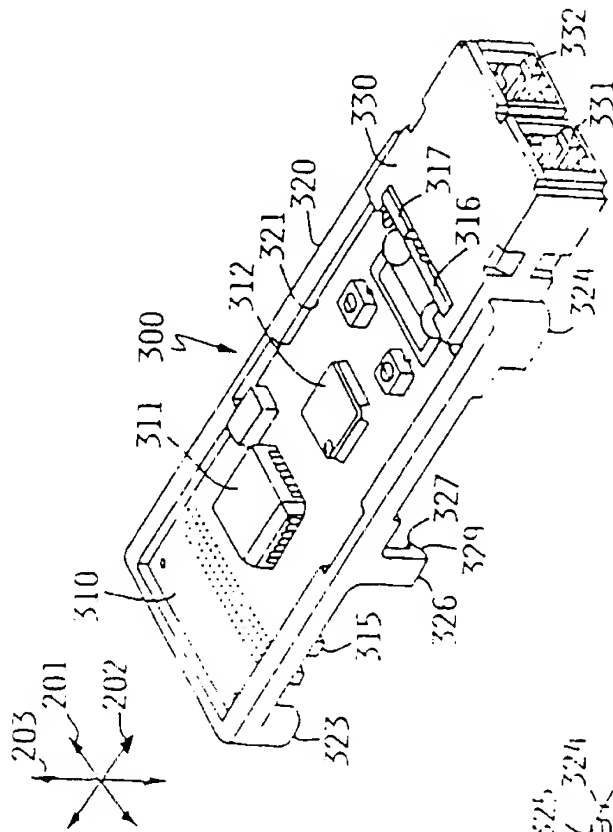


FIG. 2

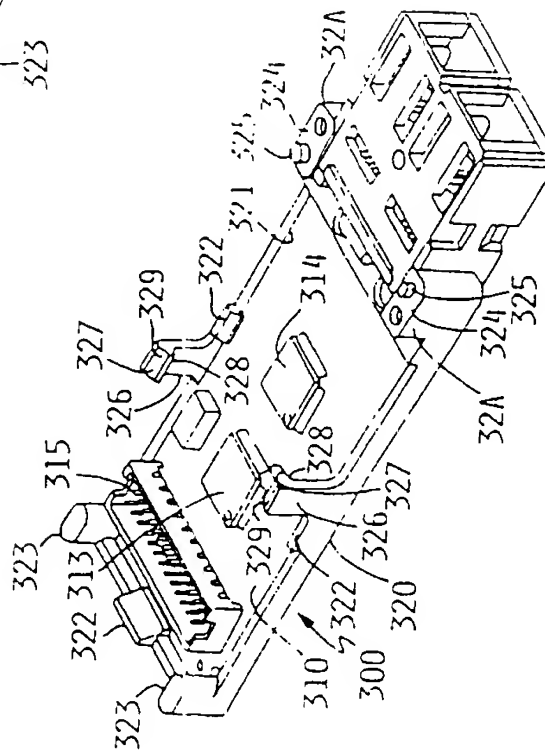


FIG. 3

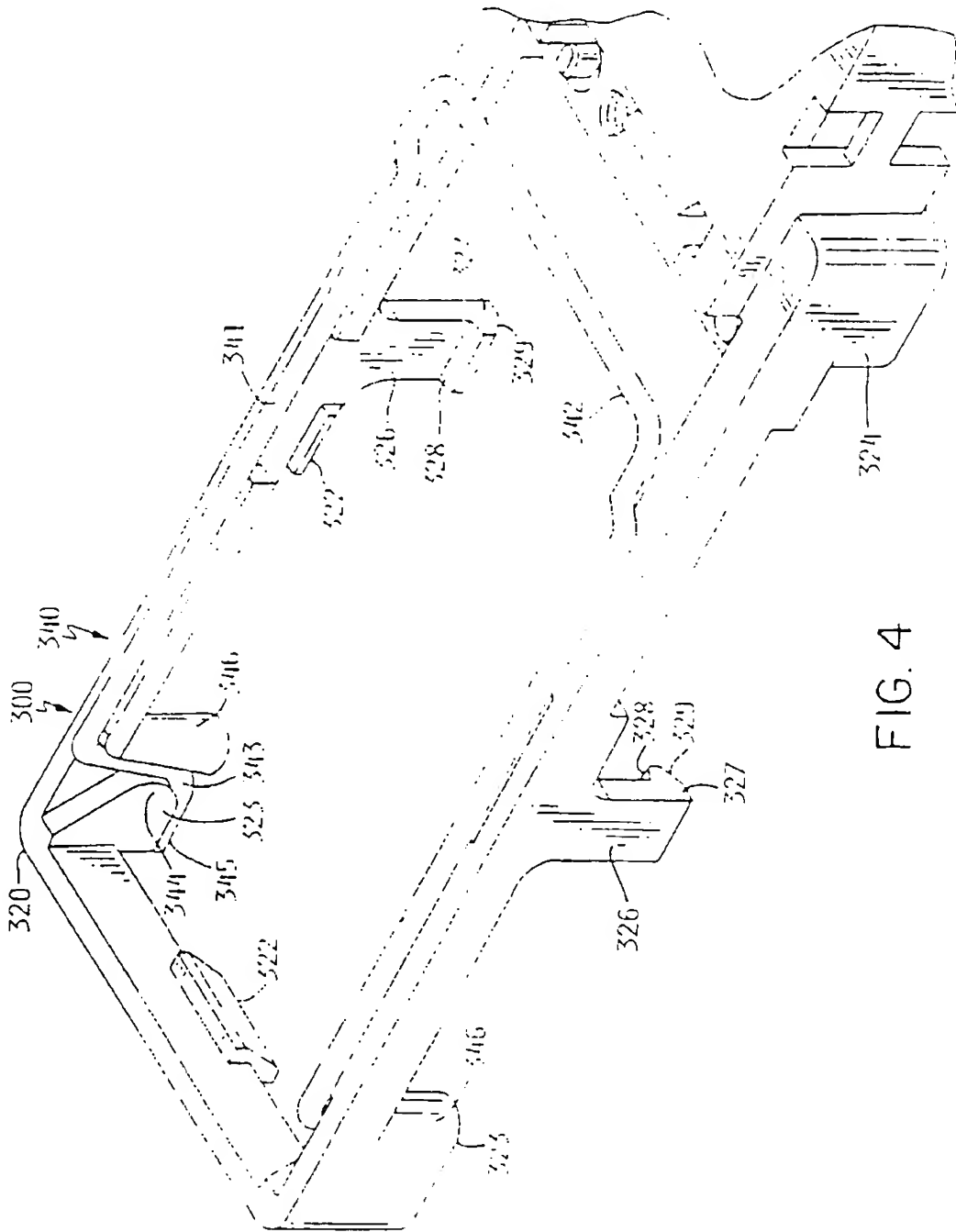


FIG. 4